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CITY OF TORONTO.

REPORT

BY THE

CITY ENGINEER,

INCLUDING

THE WORKS PERFORMED

AND

EXPENDITURE FOR SAME

IN

1882.

Annual Report of the City Engineer.

CITY ENGINEER'S DEPARTMENT,

Toronto, 30th December, 1882.

To the Mayor and Council of the City of Toronto:

Gentlemen,—I beg to submit the customary Annual Report in connection with the Works Department for the year 1882:

AMOUNTS APPROPRIATED FOR EXPENDITURE DURING THE YEAR.

1. *Under Local Improvement By-laws.*		
Pavements	$ 185,685 00	
Sewers	99,690 71	
Sidewalks	1,550 00	
Grading and bridging	4,150 74	
		$291,076 45
2. *General Service.*	$ 97,103 98	
3. *Special Services*	12,300 00	109,403 98
Total		$400,480 43

The totals for the three years previous were as follows:

1879	$ 221,306 00
1880	161,980 00
1881	306,780 00

In addition to the above, estimates and specifications have been prepared, and contracts have, in nearly all cases, been entered into, for work to the extent of $416,335, to be undertaken during the coming year; and it may be anticipated that a large amount of improvement will be petitioned for during the year, in the shape of pavements, sewers, etc.

ROADWAYS.

The past year has been the first in which the division of the Expenditure has been made under the separate heads given in Schedule No. 1, in order to meet the requirements of the Local Improvement By law; and in dividing some of the items in the Estimates it was somewhat difficult to arrive at the proportion that should be charged to each division. The expenditure shows that some of the items should have been increased in one and decreased in another.

The quantity of stone delivered for the roads during the year has been about sixteen hundred toise; and a good deal of difficulty has been experienced in procuring a sufficient supply, especially of the character required and at the price paid by the City. It is thought that more of the machine broken stone, of the class delivered during the year, might with advantage be used on the lighter travelled streets; provided the price is kept at a reasonable figure.

There are some of the main streets, which it was anticipated would be paved,

that will require a considerable quantity of material to put them in repair, and this will increase the Estimates submitted in December.

SIDEWALKS.

The estimate for sidewalks at the commencement of the year was with difficulty held at $20,000. The expenditure has been $24,000, and even with that increase the requirements of the City could not be met. There are many places where the sidewalks are in an almost dangerous condition, and also many sections where for the accommodation of the residents extensions should be made. Under these circumstances it is absolutely necessary that the estimate in this division for the coming year should be materially increased. Schedule No. 3 gives all particulars with regard to the locality where the sidewalks have been laid, with the length, &c.

GENERAL PURPOSES.

There are many charges that have come upon General Purpose account that were not anticipated when the estimate was made in the beginning of the year—thus a considerable sum from the item of labour has been expended in cleaning snow from the crossings and channels, more so than for some years past; and it was also found necessary during the year, on account of the improvement of the roadways, to spend a considerable sum in levelling and putting boulevards in order. This money it is considered has been well spent, and provision will have to be made for carrying on this work at many points where the appropriation would not admit of its being done in the year just closed. A considerable sum also has been expended in the permanent improvement of several of the old sewers, as will be seen by reference to Schedule No. 5.

SEWERS.

There are now in the City 81.22 miles of sewers of all sizes, the length having been increased by 7.10 miles during the year, and this would have been still further increased had an outlet been obtained by way of the Garrison Creek for the proposed sewer on College Street.

GARRISON CREEK SEWER.

During the summer approximate estimates were submitted for a main trunk sewer on the line of the Garrison Creek, and for an intercepting sewer along the front of the City.

The sewer on the line of the Garrison Creek is required as an outlet for several districts already sewered and discharging into the stream, as well as for other districts awaiting sewerage and having only this outlet to depend upon.

The sewer, when constructed, will necessarily be of sufficient capacity to serve as an outlet for the drainage of the whole district as far north as the water-shed of Davenport Hill, west to the Northern Railway line, and eastward to Bathurst Street. It would be proposed to make it serve in addition as an outlet for the area drained by the University stream, and by extending the branch along Bloor Street to give an outlet for the sewerage of the greater part of Yorkville.

The main sewer would follow the general valley line of the stream from Bloor Street to the Cattle Market, thence to the west of the Old Fort, with its outlet outside the harbour west of the Queen's Wharf. Intercepting branches would be constructed along College Street and Bloor Street to the east and west.

As mentioned, the branch along Bloor Street to the east would cut off the University stream at Bloor Street, and being extended to Yonge Street would receive the sewerage from Yorkville by main sewers constructed along Avenue Road and Yonge Street.

The estimate for this work is as follows:

Main sewer on line of Garrison Creek to the lake	$226,000
Branch to the west along Bloor Street as far as the railway tracks.	76,000
Branch to the east along Bloor Street as far as Yonge Street	100,000

The accompanying plan shews the sewer and its branches.

The right of way which it would be necessary to acquire along the length of the main sewer could be converted at little expense into a very fine drive, and, as has been shewn by the report of the Assessment Commissioner, the value of the Corporation property south of Queen Street would be increased in value at least one-half.

INTERCEPTING SEWER.

The plan proposed for the intercepting sewer along the front of the City provides for its being constructed of sufficient capacity to carry off the sewage proper and a certain proportion of the rain-fall from the whole area of the City now sewered and discharging into the bay, as well as from the area included in the Garrison Creek system. The sewage would be conveyed eastward to the west side of the Don, there to be passed through a set of chambers provided with suitable screens, with a view to the removal of all floating bodies and the settlement of the heavier suspended matter—the chambers being duplicate, with the object of enabling the examination and cleansing of one set whilst the others were in use. An overflow and discharging weir would be provided on the direct line of the sewer, by which the storm water, and, on occasion, the whole flow from the sewer, could be turned into the Don. Storm water overflows into the bay would also be provided at the points of intersection of the present sewers. From the chambers at the west side of the Don the sewage would be conveyed under the bed of the stream to a chamber on the eastern bank; thence by a suitable conduit eastward through Ashbridge's Bay, to be finally disposed of by discharge into deep water in the lake opposite Scarborough Heights.

An approximate estimate of the cost of this work is as follows:

Intercepting sewer along the front of the City, from the Garrison Creek to the Don, with connections, overflows, &c.	$292,000
Chambers at the Don, with pipe under the river	35,000
Conduit from the Don eastward across Ashbridge's Bay and out into the lake, as indicated on the plan	800,000
	$1,127,000

No special surveys have been made, except with regard to the sewer along Front Street, and this would have to be done before accurate plans and estimates could be prepared. Those submitted, however, are sufficiently accurate to give an approximate idea of the cost of this work.

SEWER CLEANING.

During the year a commencement was made in the direction suggested in the report of last year, and several of the sewers have been examined, cleaned, and provided with proper means of access. This work, however, has not yet taken the shape it is hoped it will, and it would be proposed during the coming year to organize a regular system of inspection and cleansing for the whole of the sewers throughout the City. This must also include the construction of man-holes upon many of the old sewers, and their renovation in a number of ways. The first year or two in connection with this work, owing to most of the sewers never having been properly examined since their construction, will undoubtedly be the heaviest in the way of expense, but the necessity for this work in a sanitary point of view, and the advantage to be gained thereby, cannot be over estimated.

By reference to Schedule No. 5 it will be seen thet the sewer on Queen Street throughout the greater part of its length has been provided, in anticipation of the pavement, with proper means of access. Early in the ensuing year it will be necessary to carry out a similar work on several other sewers, especially on King and Yonge Streets.

PAVEMENTS.

In the beginning of the year additional legislation was obtained by which the power was conferred upon the Corporation of taking what has been termed the "Initiative," with regard to street improvements. That is, where the Corporation deem it well to construct, say, a pavement, on any street, they can, without waiting for petition, signify by public notice in the daily papers that it is their intention so to do; and should no objection be made thereto, they can pass the necessary By law and proceed with the work. Should, however, a petition against the work, signed by one-half in number of the property owners on the street, be received within one month after the giving of the required notice, then the power to proceed with the work ceases; nor can the Corporation again exercise their power in that special case for two years. As far as the work done during the past year is concerned, the power of the Council in this respect has not yet come practically into effect to any extent. As will be seen by reference to Schedule No. 6, some ten miles (9.94) of pavement have been constructed under Local Improvement By-laws during the year, and of this some 9.12 miles were carried out under petitions signed by two-thirds or more in number of the property owners on the streets improved; the remaining 0.82 miles, (or 4,360 feet) only, being carried out under the new powers of the Council, and that at the instance of petitions signed by at least one third in number of the property owners.

The whole of the pavement, with the exception of one small piece, has been cedar block of the same character as that laid down last year; and, as will be

seen by reference to the Schedule, has almost, without exception, been confined to the outlying and new portions of the City.

There is no question but that when the streets in the business portion of the City come to be improved, pavement of a much more substantial character than the cedar block as now laid will be necessary. The points most strongly urged in favour of the cedar block are its comparative cheapness, as regards first cost, and noiselessness; on the other hand, it is deficient in durability, and objectionable from a sanitary point of view.

Noiselessness may, before other qualities, recommend wooden pavement in certain localities; and in many places subject to heavy traffic in the largest cities they have been put down on this account alone; but such pavements are of a very different character from the cedar block laid in Toronto, and would cost at least from two to three times as much.

There are many important points to be duly considered in selecting a pavement, and such discrimination should be exercised as not to estimate unduly the advantages or defects of any special class. There are to be considered: durability as affecting the ultimate cost, and the avoidance of the inconvenience arising from repeated repairs; facility of repair, when such is necessary; degree of resistance to traction; wear and tear to horses and vehicles; safety of foothold: and sanitary conditions, as indicated by freedom from dust given by wear of the material, imperviousness, facility in cleaning, and, to some extent, noise.

No pavement that is known will fully meet all the desiderata of a pavement, and the various qualities must be taken into consideration and fairly weighed one against the other, not forgetting the special locality and other considerations.

It is pretty generally conceded that macadam, even of the very best character of construction, is unsuitable to the heavy traffic of large cities, both sanitarily and on the score of expense; and to cobble pavements there are, if anything, more objections. The only classes of pavement that appear really to rival one another are the various kinds of stone block, wood, and asphalt.

The objections usually urged against stone pavements are their noisiness, with greater wear and tear to horses and vehicles, as compared with wood and asphalt. Both these objections, however, can be very much exaggerated, and with hard sand-stone setts or blocks properly shaped and properly laid with close joints, these objections are to a very great extent overcome. On the other hand, these pavements are more durable than any other class: offer an excellent foothold to horses, are easily and quickly repaired, and when the joints are made with water-proof material are sanitarily irreproachable.

Wooden pavements, if of the best class suitable to heavy traffic, are nearly as expensive in first cost as stone, without the durability; and even when the wood has been subjected to a preservative process, are sanitarily objec-

tionable. On the other hand, they give perhaps the best results as regards noise and wear and tear.

With asphalt pavements, as usually laid, wear and tear are slight, also noise; resistance to draught at the minimum, and sanitary conditions perhaps the most completely filled. But they are most dangerous to horses, affording, from the fact of their hard, smooth surface, little or no foothold; and with a climate such as Toronto, ranging between such extremes of heat and cold, it is questionable how far they would be suitable.

Practical experience cannot fail to a very great extent in bringing to the front the qualities that in the long run are the most desirable where a choice has to be made; and on this account it may not be amiss to refer to the opinions formed on the subject of pavements by those who have had the results of experience before them in some of the largest cities of this continent, these being more of a character with our own, in climate, class of streets, and habits of the people.

In New York the use of wooden pavements has been entirely abandoned for some years, and the Commissioner of Public Works in his report of January, 1879, writes as follows:—"The health and comfort of the City demand that all the wooden pavement at present remaining should be replaced with stone blocks as early as possible."

The Chief Engineer to the Board of Commissioners of City Works of Brooklyn writes as follows, in his report of February, 1880: "The dilapidated wooden pavements are rapidly being replaced, and I hope all important thoroughfares will soon be paved with granite block pavement."

At Washington the maintenance of the streets has since 1878 come under the control of a Commission appointed by the United States Government, and the supervision of the work is undertaken by Government military Engineers. There were formerly, under a different organization, many miles of wooden pavement laid down; but these have been condemned in the strongest terms and are rapidly being replaced by stone and asphalt, the latter having apparently very much the preference with the Engineers, large quantities being laid down each year.

The following extracts from reports of St. Louis show the tendency in that City. The Street Commissioner writes under date of April, 1879: "The Board will at an early day recommend ordinances for paving some of our most important thoroughfares, subject to greatest wear, with granite, a material whose fitness and economy for such streets are no longer a matter of experiment * * * owing to the short life and consequent great cost of repairs of ordinary wooden pavement;" and the following year he also writes, referring to certain streets: "The traffic over these streets has attained enormous proportions in the last three years, and no pavement can possibly hold up under it other than a stone block;" and the Mayor, in his message for the same year, says: "I agree with the Street Commissioner in thinking that at such places nothing but granite blocks

will answer the purpose. Main Street from Poplar to Plum was paved with granite last year; as a consequence there is no expenditure for repairs this year, nor is any likely to occur for a period of nearly a decade. The result on this block shows what large sums of money can be annually saved by extending granite pavement."

In their report for the year 1878, the Commissioners of Public Works of Milwaukee write as follows: "The question of the kind of pavement most proper to be used in paving the streets of this city is one of great interest and importance. Within the last year this board has made research and had much correspondence with engineers and expert authorities of other cities upon the subject. There appears to be nothing like a uniform opinion in regard to the proper pavements to be used, except as to streets where the heaviest traffic prevails. All agree that for streets where immense traffic is continually going on, nothing has been found which combines the chief requisites of good pavement, viz., even surface, durability and economy, that will compare favourably with a first-class stone pavement; and by adopting such pavements for such of our streets as are the most convenient for heavily loaded teams to use in carrying heavy freight from one point to another in the city, to that extent we will be practising economy above criticism. In order to make a good street surface it is necessary that great care should be practised in the preparation of the foundation and in the construction of the pavement, using only such materials as are suitable for the purpose, and putting them into the work in a proper manner; and in order to preserve and keep good such street surface it is necessrry that it should not be opened for the laying of water, sewer, or gas pipes, or for any other purpose.

"As to what style of pavement should be adopted for such streets as are not required for the heaviest loaded teams, but over which are continually passing and repassing vehicles of all descriptions, from the lightest to the heaviest, where a pavement which should be comparatively noiseless, as well as smooth, durable and economical, is a question of the first importance, and is the question upon which the greatest diversity of opinion exists; and generally will be settled by adopting that style of pavement, the principal material entering into the construction thereof, which is most easily and cheaply procured, and at the same time will make a surface of the required quality.

"The facilities in this locality for obtaining the proper materials out of which to construct wood pavement, and the rapid progress which can be made in their construction, and the great beauty of such pavements when in perfect condition, have been strong arguments in favor of their use.

"Had the city authorities, in paving streets, adhered to the original specifications for Nicholson pavement, with such minor modifications as long experience might have suggested, we would have been spared much of the trouble and expense to which we have been subjected by using the cheaper and inferior styles of wood pavement.

"It is the opinion of some experts that some of the Wauwatosa quarries contain very good materials for making Telford and Macadam pavement. Should that material prove, with use, to be of the quality which its advocates expect, an abundance of material for all required roads of that description can be procured there at moderate cost. We believe that Macadam or Telford pavement for many of our thoroughfares and drives would be found most attractive and appropriate.

"Much care and attention is required in doing proper repairs, and in cleaning and sprinkling them, and such proper supervision would make them very attractive.

"The asphalt block has the hearty approval of some eminent Engineers and road-makers. Col. B. S. Alexander, of the United States Engineers, writes in reference to asphalt blocks, as follows:

"'I believe that these blocks, when their merits are once understood, are destined to supercede both wood and stone as a paving material for the principal streets in our cities. I believe they possess all the qualities for making a better pavement than any other material that has yet been tried. They will be cheap, durable, easily repaired, and almost noiseless. They will admit of being readily taken up and replaced when new water or gas pipes are to be laid.'

"The vital importance to this city of obtaining the best pavement in use for our business streets should be sufficient excuse for trying a pavement which merits the approval of such eminent authority, as is the case with the asphalt block pavement; and we believe that such an experiment would promote the true interests of the city."

It may be mentioned, in reference to the last paragraph of the foregoing report, that the class of pavement there alluded to is one constructed of asphalt, which is compressed into rectangular blocks, laid in courses across the street in a similar manner to stone pavement and upon similar foundations.

Commissioner Waller, of Chicago, in his report of 1880 refers in the following terms to the wooden pavements of that city, and suggests the use of stone: "The cheap and short-lived wooden pavements of the city are a species of shoddy that should not be encouraged.

"I think the best quality of stone blocks that are obtainable at a reasonable expense, skilfully laid upon a thoroughly prepared and compacted road bed, paving the gutter with selected cobble stones of small and uniform size, would make the best and cleanest streets for our business centre, and certainly the most durable;" and then follows the suggestion that macadam should be used for the rest of the streets.

His predecessor in office, however, whilst suggesting stone block pavement for the streets subject to heavy traffic, considered the wooden pavement suitable in all other cases; and the engineer expresses his opinion as follows: "I am of the opinion that for streets occupied by wholesale firms and manufac-

turers, where the traffic is principally by heavily laden teams, pavement of stone block, of uniform thickness, properly laid, will eventually meet with the favour of property owners. The objections to stone pavement are the original cost being greater than wooden blocks, and the noise made by trucks and waggons, and wear and tear on horses and vehicles. This is offset by the fact that the lasting qualities of the pavement are three or four times that of wooden blocks. For instance, La Salle Street, from Randolph Street to Washington Street, was paved with stone blocks from the canal quarries in 1858, nineteen years ago, and is still in condition, with ordinary repairs, to last several years."

Judging from the rate at which wooden pavements continue to be put down year after year in Chicago, it is evident that the weight of public opinion still stands in favor of wood; at all events in the case of the majority of streets. Cedar block, with or without plank foundation, is the pavement used.

In Buffalo and Cleveland wooden pavements have been entirely abandoned, and their place has been taken almost exclusively by pavements constructed of hard, gritty sandstone blocks, called "Medina sandstone pavement." These pavements, when properly laid with close joints, and evenly cut blocks, as they can and should be, offer almost as little resistance to traction as asphalt, and at the same time afford an excellent foothold to animals, not being liable to polish, as granite; and as to noise, this is reduced to a minimum by the close joints and even surface, and is infinitely less than on such macadam streets as are common in Toronto.

In the Report of the Engineer Department of the District of Columbia for the year 1880, is submitted a Report of the Chief Engineer of the streets of Paris, made at the request of the United States Minister to France, and it is remarked that "it embodies the experience of what is usually considered the best paved city in the world."

The Report states: "The total length of the streets in Paris is 557 miles; this length is divided as follows, according to the nature of the road covering:

Stone pavement	392.54 miles.
Macadam	144.76 "
Asphalt	19.76 "

"*Stone Pavement.*—The streets are for the most part paved with blocks of sandstone grit, which come either from the suburbs of Paris or from more distant quarries."

The cost is placed at from $2.58 to $3.23 per square yard, and its average durability at about thirty years.

"There still exists in Paris certain streets paved with Belgian trap. This kind of road covering, which becomes extremely slippery by wear, is now abandoned."

Of macadam it is remarked that "it has been considerably diminished in the last ten years in consequence of the difficulty of maintenance and of the ex-

pense resulting from it"; and thereafter follow figures relating to the cost of maintenance.

Of the asphalt pavements the report says: "The use in Paris of compressed asphalt dates from 1866; it gained in a few years a rapid development, but since 1871, for reasons of economy and also as the result of more exact understanding of the conditions of such work, its use has been sensibly diminished and appears destined to remain restricted." It "becomes excessively slippery in times of damp, fogs and fine rain"; it "must be proscribed on streets having a grade greater than $\frac{1}{100}$, and on those which, although on easy grades, have heavy traffic." On "narrow, damp streets it cannot be maintained." It should be employed "only on those streets already provided with all the underground accessories," and "it is very difficult to make the necessary repairs to it during the winter in case of frosts or continuous rains."

It is used "where absence of noise is particularly desired," and "produces neither mud nor dust," but "it is much dreaded by horsemen and pleasure carriages."

It may be mentioned that Paris has probably twice the amount of asphalt pavement that all European and American cities have together, and, consequently, it is thought its experience in regard to this class of roadway may be pretty confidently relied upon.

It is noticeable that no mention is made of any experience with wooden pavements in this report, and it certainly shows none to be in existence.

An earlier report from Paris, quoted from in *Engineering News* of 1878, states that "hard sand-stone is that almost exclusively used" for stone pavements, granite not being used, and porphyry being abolished. It also states that "trials of wood pavements have been made on a large scale," and gives prices of the first cost and maintenance; and it further compares the qualities of the sand-stone, wood and asphalt pavements. Of the sanitary effects of wooden pavements it remarks: "Notwithstanding any defects therein, no complaint has ever been addressed to the administration touching its sanitary condition." The trials of the wooden pavements, however, it is thought, cannot, in the long run, have proved very satisfactory, as no mention is made of them in the report of two or three years later, which is quoted from above.

There is no question but that for the main business streets stone pavements, properly constructed, will, taking everything into consideration, prove the most satisfactory; and the property owners will do well to consider the matter carefully when petitioning the Corporation for the improvement of their roadways.

With regard to the question of opening the paved streets for the purpose of putting in drain and water connections, this was the subject of careful enquiry in the beginning of the year, and the Committee on Works reported at length to the Council on the subject. The particulars of the recommen-

dation are given in Report No. 14 of the Committee; and the sum subsequently fixed upon was $3 in the case of each connection.

Schedule No. 7 gives the localities and lengths of pavements which it is the intention of the Corporation to construct during the coming year under Local Improvement By-laws that have been passed. The object of passing the By-laws and letting the work a season in advance, has been that the contractors might take advantage of the winter season to collect their material; thus being enabled to carry the work out at a less cost and with greater rapidity when commenced. These By-laws provide for the construction of something over eleven miles of pavement, and it may be anticipated that considerable additions will be made by petitions presented during the coming year.

The whole of this, with the exception of eleven hundred feet, will be cedar block pavement. The eleven hundred feet it is proposed to construct of stone—either Medina sandstone or that of equal quality.

SPECIAL APPROPRIATIONS.

Schedule No. 8 shows the expenditure and balances remaining at the credit of several special appropriations to the Department.

Huntley Street—This is a small balance that remains over from the reconstruction of the sewer on Huntley Street. The work was completed in the latter end of 1881, but the payments were not all made until the past year.

Sherbourne Street—This is an appropriation made late in the year to cover the expenditure for the reconstruction of the sewer on Sherbourne Street, between King and Queen Streets. The old sewer, though in fairly good condition, was not of sufficient depth to intercept the stream that crosses Sherbourne Street between Britain and Queen Streets, nor deep enough to give an outlet to Queen Street. In anticipation of the reconstruction of the upper part, an outlet to the Bay had been reconstructed in the early part of the year. The sewer, as now constructed, gives a direct outlet to the Bay for the Sherbourne Street district, and relieves Parliament Street, besides preventing for the future a recurrence of the damage caused by flooding along the lines of the old stream eastward. The work has only recently been completed, and the balance is required to meet outstanding liabilities.

Arthur Street Extension.—This appropriation was made with the object of opening out Arthur Street from Hope Street westward to Dundas Street, including the construction of a bridge across the ravine. The bridge has been nearly completed; and the balance is required to finish the work and to meet outstanding liabilities.

Eastern Avenue Extension.—This is an appropriation that has been added to from time to time for several years, with the object of securing an inlet to the Eastern part of the City free from toll. The greater part of the work has

been completed, the grading and culverts having been finished, as well as the greater part of the fencing. The balance is required to meet outstanding payments on the work done and for the sidewalk which is under tender, and will be laid next year.

Garrison Creek Straightening.—This is a small balance standing over from the sum appropriated for straightening the course of the Garrison Creek.

Crawford Street.—This is an appropriation that was made for the construction of a bridge across the ravine at the intersection of Crawford and Arthur Streets.

The appropriation was made under the terms of the agreement with the Ontario Industrial Loan and Investment Company in lieu of land given for Bellwoods Park.

The bridge on Crawford Street has been almost completed, and also a small portion of the Shaw Street bridge south of Arthur Street. The balance, with an additional appropriation, will be required to complete the work.

Eastern Avenue and Gerrard Street Bridges.—These are small balances remaining over from the appropriations for the construction of the above-named bridges in 1880.

AREA AND POPULATION.

The area of the City within the following limits, viz., bounded on the west by the west line of Dufferin Street, on the north by the north line of Bloor Street, on the south by the Windmill line, and on the east by the Don, is 4,556 acres. The area east of the Don, bounded on the north by the south line of the Kingston Road, on the east by the eastern limit, and on the south by the water line, and exclusive of the Marsh and Ashbridge's Bay, is 522 acres.

This makes the total area of the City, leaving out of consideration the Island, 5,078 acres.

It is distributed in the various Wards as follows:

	Acres.
St. George's Ward	811
St. Andrew's Ward	375
St. Stephen's Ward	989
St. Patrick's Ward	676
St. John's Ward	293
St. James' Ward	294
St. Thomas' Ward	290
St. David's Ward	582
St. Lawrence Ward	768
Total	5,078

Taking the Assessment Commissioner's return of the population, viz., 86,585,

as a basis, the density of population would be as given in the following division:

St. George's Ward.—Although the Ward contains 811 acres, the population is confined almost entirely to an area of about 200 acres, which, with a population of 4,492, gives a density of 22·46 individuals to the acre. The rest of the area is occupied by the Government Reserve, the Exhibition Park, &c.

St. Andrew's Ward.—The area given is 375 acres; but, as in the previous case, the population is confined to about 261 acres, giving, with the population of 11,378, a density of 43·6 to the acre. The rest of the area is composed of the Government and railway lands.

St. Stephen's Ward.—Whole area 989 acres; population, 7,846. The population is very scattered, and gives a density of but about 8 to the acre; or, taking only the portions built up, it would reach about 24 to the acre.

St. Patrick's Ward.—There is also a great deal of unoccupied land in this Ward. Taking the whole area of 676 acres, and the population 15,589, the density is about 23 to the acre.

St. John's Ward.—The area given is 293 acres, inclusive of the Park and University land. The density is in this case, with a population of 11,900, nearly 41 to the acre. The lower part of the Ward is one of the most densely populated parts of the City.

St. James' Ward.—Area 294 acres; population, 10,397; density, 35 to the acre.

St. Thomas' Ward.—Area, 290 acres; population, 8,713; density, 30 to the acre.

The density of population is less likely to increase in these last two Wards than in perhaps any in the City, there being little unoccupied land, but several squares, and numbers of residences surrounded by grounds.

St. David's Ward.—The area given is 582 acres; but this includes the two large cemeteries—St. James' and the Necropolis; and even in the remaining portion there are large areas yet to be filled up. The present population, 11,802, is spread over an area of about 400 acres, giving a density of 29.5 to the acre.

St. Lawrence Ward.—The whole area is 768 acres, of which 522 acres lie to the east of the Don. The population is 4,468, inclusive of that east of the Don, which is 947. Taking the area west of the Don, namely, 246 acres, and the population in that area, namely, 3,521, the average density in this locality is a trifle over 14 to the acre.

Taking the whole area of the City, exclusive of that portion between the Esplanade Line and the Windmill Line water lots, and exclusive of that east of the Don, namely, 4,390 acres, and dividing this into the proportion of population, say 85,000, the density would only reach a fraction over 19 to the acre.

The sparseness of population in Toronto is very marked when compared

with that of cities in Britain and the European Continent, as will be seen from the following:

	Population on Area given.	Area.	Density.
Birmingham	300,000	8,000	37½
Leicester	93,000	1,300	71½
Liverpool	500,000	7,014	71¼
London	3,000,000	59,010	51
Nottingham	120,000	1,800	66⅔
Plymouth	75,000	600	125
Preston	83,000	2,418	34⅓

In London the density runs as high as 174 to the acre in some districts.
Paris, the average density is 96 to the acre, though in the "old city" it runs as high as 313.
Berlin varies between 7 and 192, the average being 71 to the acre.
Vienna, average density, 64 to the acre.
Hamburg, " 92 "
Frankfort, " 73 "
Dantzic, " 66.6 "
Amsterdam, " 188 "
Breslau, " 46 "
In Hamburg it runs as high as 445 to the acre in places.

The most densely populated portion of Toronto, as indicated by the figures given, is St. Andrew's Ward, at 43.6; St. John's Ward follows, at 41; and thereafter St. James' and St. Thomas' Wards, at 35 and 30 respectively. Looking to these figures, it is thought it may be fairly assumed that the population of the City per acre will never exceed 50.

Taking the 4,390 acres west of the Don, and included by the other boundaries to the north, south and west, and multiplying it by the 50, it would give a prospective population of nearly 220,000 inhabitants on the area, about $\frac{5}{6}$ths of which is already supplied with sewers, water pipes, roads and sidewalks, and all of which have been constructed and are being maintained by a population of about 85,000 inhabitants.

The tendency always is to compare the condition of the various public services in Toronto with those in the largest British and European cities, leaving entirely out of consideration the difference of circumstances. Had Toronto a population on its area equal to that of the smallest given in the list above, the proportion of any expenditure on the construction and maintenance of public works would be reduced to probably little more than half to those who have to pay.

Respectfully submitted.

REDMOND J. BROUGH.

P.S.—Since the closing of the foregoing, a Report by Dr. Wight, the Health Officer of Detroit, on the subject of pavements, has come to hand; and the liberty has been taken of reproducing it in the Appendix.

SCHEDULE No. 1.

ABSTRACTS OF GENERAL APPROPRIATIONS AND EXPENDITURE.

Abstract of Appropriation and Expenditure on Roadway Account, 1882.

Appropriation	$65,000 00	
Less transferred to G. P. and Sidewalk Account.	4,000 00	
		$61,000 00
Expenditure		
1. Labour	$20,967 51	
2. Stone (including breaking)	24,966 43	
3. Lumber	5,317 91	
4. Spikes, Nails, &c	536 90	
5. Repairs to Tools	274 42	
6. Cement, &c	141 15	
7. Sundries	235 64	
Amount to cover Liabilities	8,560 04	
		$61,000 00

Abstract of Appropriation and Expenditure on Sidewalk Account for 1882.

Appropriation and Transfer up to date		$24,000 00
1. Labour	$ 7,590 95	
2. Improved Sidewalk, (City's proportion of cost)	96 25	
3. Lumber	15,301 72	
4. Nails and Spikes	910 79	
5. Buggy Hire (paying labourers)	14 00	
Amount to cover Liabilities	86 29	
		$24,000 00

Abstract of Appropriation and Expenditure on General Purpose Account, 1882.

Appropriation and Transfers, &c., up to date		$12,103 98
Expenditure:		
1. Labour	$ 8,907 06	
2. Repairs to Instruments	80 70	
3. House Numbering	7 60	
4. Ironwork	1,243 87	
5. Postage Stamps	40 20	
6. Bricks	378 90	
7. Tools, etc	457 87	
8. Cement, &c	387 85	
9. Tin Boxes	20 51	
10. Lumber	52 01	
11. Jobbing Brick Work, &c	177 47	
12. Maps, Plans, &c	70 10	
13. Buggy Hire (paying labourers)	17 00	
14. Rent of Telephone	25 00	
15. Mercantile Agency	50 00	
16. Repairs to Tools	6 60	
17. Rent of Yard	60 00	
18. Printograms	6 00	
19. Sundries	35 20	
Amount to cover Liabilities	80 04	
		$12,103 98

SCHEDULE No. 2.

Abstract of Stone Delivered for Roadways, 1882.

Contractors.	Quantity. (Toise.)	Price Per Toise, Unbroken.
		$ c.
Corporation	188.54	
Matthews	26.39	12 00
Maloney	269.42	12 00
Hunter	119.32	12 25
Gooderham	44.20	$12 00 and $16 75*
Godson	6.09	12 00
Devlin	2.87	12 00
McLeod	33.83	12 25
Hurd	18.43	12 00
Dinnis	3.41	12 00
Everard	0.96	12 00
Hilts	315.70	10 75
Playter	8.85	10 75
Goldring	195.14	10 75
Snarr	17.82	10 75
Farquhar	348.67	15 50†
Ardagh & Leonard	5.68	10 75
Total	1,605.32	

* $16.75—Broken Stone, East Division. † Machine Broken Stone.

SCHEDULE No. 3.

Table shewing the locality, length and width of Sidewalks constructed out of General Appropriation for 1882.

No.	Street.	Side.	From	To	Width and Length of Sidewalk in feet.				
					2 ft.	4 ft.	6 ft.	8 ft.	12ft.
1	Anne	N	Yonge	Easterly			135	255	
2	Adelaide	S	Toronto	Yonge					380
3	Anne	N	Church	Mutual			405		
4	Bathurst	W	College	Southerly					56
5	Balmuto	E	Bloor	Czar		548			
6	Bathurst	W	Queen	King				1199	
7	Bay	E	Queen	Richmond				298	
8	Bay	W	King	Wellington					348
9	Bloor	S	Yonge	Church			990		
10	Bleeker	B	Carlton	Howard			5617		
11	Boulton	B	York	Simcoe			1485		
12	College	W	Clinton	Westerly			43		
13	Clinton	W	College	Southerly		84			
14	Clifford	W	Strachan Av.	Eastward		192			
15	Chestnut	E	Queen	Albert			485		
16	Coolmine Av.	W	Dundas	Northerly		498			
17	Cameron	W	Bend	Southerly			103		
18	Caer Howell.	S	Park Gate	Simcoe				142	
19	Chestnut	W	Queen	Osgoode			513		
20	Cameron	E	Queen	Northward		268			
21	Clinton	W	College	Northward		1689			
21	Clinton	E	College	Northward		212			
21	Church	E	Carlton	Alexander			582		
22	Carlaw	E	Eastern Ave.	Southerly	800				
23	College	W	Markham	Westward		71			
24	D'Arcy	S	McCaul	Beverley			625		
25	Dundas	B	Argyle	Northward				185	
26	Dufferin	E	Dundas	Church			416		
27	Dovercourt R	W	Queen	Argyle			979		
28	Denison Ave.	E	Eleanor	Bellevue Av.			1268		
29	Draper	W	Front	Northward		214			
30	Duke	S	Jarvis	George			286		
31	Duke	S	Berkeley	Parliament		226			
32	Dufferin	E	Alma Av.	Trafalgar Av.	248				
33	Dovercourt R	E	Queen	Argyle			1020		
34	Front	W	Cherry	Eastward			222		
35	Elizabeth	W	Edward	Elm			288		
36	Givens	W				66			
37	Garrison	B	Niagara	Tecumseth			1630		
38	Grenville	B	St. Vincent	Surrey Place			1210		
39	Gerrard	S	Sherbourne	Pembroke			352		

SCHEDULE No. 3.—*Continued.*

No.	Street.	Side.	From	To	Width and length of Sidewalk in feet.				
					2 ft.	4 ft.	6 ft.	8 ft.	12ft.
40	Gerrard.....	N	Jarvis	Easterly.....			188		
41	Gerrard.....	S	Seaton.....	Ontario.....			221		
42	Huron.....	E	College	Northerly....		118			
43	Hope.....	E	Robinson.....	Arthur.....			1226		
44	Huron.....	E	Phœbe.....	College.....			2533		
45	Harrison.....	S	.....	.....	125				
46	Huron.....	W	Bloor.	Sussex Ave..		755			
47	Huron.....	W	Phœbe.....	Sullivan.....			225		
48	Huron.....	W	Sullivan.....	St. Patrick...			698		
49	Hope.	W	Bet. College and Bloor.	....		1390			
50	Jarvis.....	E	Wilton Ave.	Shuter			623		
51	Jarvis.....	E	Wellesley....	Bloor.....			1961		
52	King.....	N	Tecumseth...	Niagara.....			558		
53	King.....	S	Niagara.....	Walnut Ave.			368		
54	King.....	W	Bet. Bathurst and Portland	....					55
55	Louisa.....	N	Yonge.....	Terauley.....			812		
56	Lakeview Av.	W	Harrison.....	Northerly....		275			
57	Lisgar	W	Queen.....	Argyle.....			980		
58	Lorne.....	W	Front.....	Esplanade....			448		
59	Lisgar	W	Argyle	Westerly.....	330				
60	Louisa.....	N	.....	.....				85	
61	Lakeview Av.	W	Harrison.....	Dundas.....		389			
62	Muter	W	Robinson.....	Arthur.....			1350		
63	Markham.....	W	Arthur.....	Northerly....			750		
64	Melinda.....	S	Bay.....	Yonge.....				510	
65	Muter	E	Arthur.....	Northerly....		398			
66	McCaul.....	W	St. Patrick...	D'Arcy.....			321		
67	McDonnell S.	S	Bathurst.....	Northerly....			136		
68	Melinda.....	N	Bay.....	Yonge.....				448	
69	Montague Pl.	B	Homewood A	Westerly.....			611		
70	Mill	N	Trinity.....	Cherry.....			536		
71	Mill	S	Trinity.....	Easterly.....		314			
72	Mutual.....	W	Wilton Ave.	Gould			605		
73	Magill	N	Church	Yonge.....			312		
74	Melady's L'e.	E	St. David.....	Wilton Ave.	426				
75	Muter	E	Robinson.....	Southerly....		155			
76	Massey	E	King.....	Old Walk....		212			
77	Northcote Av	E	Queen.....	Northerly....		355			
78	Ontario.....	W	Carlton.....	Prospect.....			275		
79	Oak	B	River.....	Don River....		1167			
80	Niagara.....	W	King.....	Southerly....					103

SCHEDULE No. 3.—*Continued.*

No.	Street.	Side.	From	To	Width and Length of Sidewalk in feet.				
					2 ft.	4 ft.	6 ft.	8 ft.	12ft.
81	Portland	E	Front.	King.			1070		
82	Peel Ave.	S	Dufferin	Gladstone Av		382			
83	Palace	E	Wellington..	Northerly		210			
84	Queen's Wh'f	E	Bridge	Railway tr'ks		365			
85	Queen	N	Terauley	Chestnut.					502
86	Queen	N	Yonge	Easterly					162
87	Queen	N	Church	Westerly				309	447
88	Queen	S	Strachan Av.	Westward.				36	
89	Renfrew	W	Queen	Grange Road			745		
90	Richmond.	N	Niagara.	Tecumseth.		748			
91	Richmond.	S	Peter	John			690		
92	Rose Ave.	B	Prospect	St. James Av.			2101		
93	Rose Ave.	W	St. James Av.	Howard.			496		
94	St. Nicholas.	W	St. Mary	Southerly.		102			
95	St. Joseph.	S	St. Vincent .	Queen's Park			656		
96	St. Joseph.	N	Queen's Park	Lane			918		
97	St. Mary's.	S	Yonge	Chapel Lane.			585		
98	St. James Av.	S	Rose Ave.	Ontario.			317		
99	St. James Av.	S	Rose Ave.	Parliament.			361		
100	Stafford.	W	King	Clifford.		930			
101	Stafford.	E	King.	Adelaide.		655			
102	Spadina Ave.	W	College	Crescent.			370		
103	Simcoe.	W	Queen	Northerly.					200
104	Simcoe.	E	Wellington.	Southerly.					51
105	Spadina Ave.	W	Harbord	Northerly.			70		
106	Strachan Ave	W	Queen	King.			1310		
107	Selby	B	Sherbourne .	Huntley			1216		
108	Spruce	N	Sackville	Gifford		184			
109	Shuter.	N	Jarvis	George			288		
110	Sherbourne.	E	Shuter	Wilton Ave.			789		
111	Sackville	W	Gerrard	Spruce			511		
112	Shuter	N	Church	Bond				287	
113	Shuter	N	Victoria	Yonge			345		
114	Shuter	S	George	Eastward			383		
115	Sherbourne.	W	Linden	Northerly.			226		
116	Simcoe	E	Esplanade.	Front.					320
117	Sussex Ave.	S	Major	Spadina Ave.		690			
118	Terauley	W	Queen	Albert			585		
119	Tecumseth.	E	Niagara	Railway tr'ks		291			
120	Toronto.	B	Court	Adelaide.					102
121	Trinity	B	Front	Mill			1105		
122	Trafalgar Av.	S	Dufferin	Easterly	135				
123	Trinity Sq.	B	Yonge	Church			456		

SCHEDULE No. 3.—*Continued.*

No.	Street.	Side.	From	To	Width and Length of Sidewalk in feet.				
					2 ft.	4 ft.	6 ft.	8 ft.	12ft.
124	Wellington..	N	York.....	Bay.....			1208		
125	Wellington..	S	Simcoe.....	Easterly					140
126	Wellington..	B	Simcoe.....	York.....			495		625
127	Wellesley....	N	Parliament..	Easterly		396			
128	Walz's Lane.	W	Duchess	Queen.....		294			
129	Wellington..	S	Bet. Yonge &	York.....					35
130	York.....	E	Esplanade....	Front.....				419	
			Total miles...	14.39	2064	14843	51684	4173	3526

Of the above 2.63 miles have been laid where none previously existed.

List of Sidewalks laid, under Local Improvement By-laws, for 1882.

No.	Street.	Side.	From.	To.	Length of Sidewalk in feet.			
					4 ft.	6 ft.	8 ft.	12 ft.
1	Henry.....	B	Cecil.....	College.....		1178		
2	Huntley.....	B	Earl	Bloor.....		2542		
3	Linden.....	B	Huntley	Sherbourne .		1200		
4	McCaul.....	B	Grange Road	Anderson....		1361		
5	Yonge.....	B	King.....	Bloor.....				14154
						6281		14154

Length of Sidewalks laid out of the General Appropriation..... 14.39 miles.
Length of Sidewalks laid under Local Improvement By-laws.... 3.87 "

18.26 miles.

Quantity of Lumber procured for Sidewalks, Crossings, &c., 1,805,000 ft. B.M.

SCHEDULE No. 4.

Table shewing the locality, length, size, and description of all new Sewers constructed during 1882; *also items of private drains.*

No.	STREET.	FROM.	TO.	SIZE.	DESCRIPTION.	Length in Yards.	Total length of various kinds.	
1	Sherbourne st.	S'h of Front st.	The Bay	5ft.x2ft. 8in.	Brick	167		
							167	
2	Bathurst st.....	College st.....	Bloor st.....	3 x 2 feet.	"	1,090		
3	Conway st.... / Clinton st...	Strachan st....	Bloor st.....	3 x 2 "	"	1,284		
4	Eastern ave.	Trinity st.....	Sumach st.....	3 x 2 "	"	647		
	Sumach st...	Eastern ave....	King st.....	3 x 2 "				
	Sackville st.	Eastern ave....	King st.....	3 x 2 "				
5	Eastern av.....	McGee st.....	River Don	3 x 2 "	"	710		
6	Hope st.....	College st.....	Buller st.....	3 x 2 "	"	427		
7	Queen st.....	River st.....	Sumach st.....	3 x 2 "	"	207		
8	Sherbourne st.	King st.....	Queen st.....	3 x 2 "	"	583		*
9	Sumach st.....	King st.	Gerrard st.....	3 x 2 "	"	957		
							5,905	
10	Adelaide st....	John st.....	Peter st.....	18 inches..	Pipe.	220		
11	Beaconsfield av	Saurin st.....	Dundas st.....	18 "	"	327		
12	Carlton st.....	Sackville st....	Sumach st.....	18 "	"	250		
13	Carlton st.....	Yonge st.....	Easterly	18 "	"	190		*
14	Clyde st	Spadina ave....	Western term.	18 "	"	230		
15	Douro st.....	Tecumseth st...	Niagara st...					
	Niagara st....	King st.....	Douro st.....	18 "	"	420		
	Wellingt'n av	Niagara st.....	Creek					
16	Dalhousie st....	Gould st.....	Shuter st.....	18 "	"	420		
17	Dalhousie st....	Gould st.....	Gerrard st	18 "	"	207		
18	Gifford st.....	Carlton st.....	Spruce st.....	18 "	"	150		
19	Howard st.....	Parliament st.	Bleeker st.....	18 "	"	430		
20	Lisgar st.....	Saurin st.....	Dundas st.....	18 "	"	284		
21	McGill st.....	Yonge st.....	Easterly	18 "	"	137		
22	McCaul st.....	Grange Road...	Anderson st....	18 "	"	236		
23	Maple st.....	Carlton st.....	North end	18 "	"	87		
24	Markham st....	College st.....	Buller st.....	18 "	"	427		
25	Markham st....	College st.....	Arthur st.....	18 "	"	483		
26	Markham st....	Arthur st.....	Robinson st....	18 "	"	483		
27	Muter st.....	College st.....	Arthur st.....	18 "	"	484		
28	Regent st.....	St. David st....	Wilton ave.....	18 "	"	150		
29	Spruce st.....	300ft.e. S'vlle st	Sumach st.....	18 "	"	134		
30	Sydenham st...	Sackville st....	Sumach st	18 "	"	250		
31	Sydenham st...	Parliament st...	Regent st.....	18 "	"	134		
32	Shaw st.....	Cecil st.....	Queen st.....	18 "	"	507		
33	Wilton ave.....	Sumach st.....	Easterly	18 "	"	64		
34	Winchester st.	Sackville st....	Sumach st	18 "	"	250		
35	Winchester st.	Medcalfe st....	Westerly	18 "	"	70		
36	Trinity st.....	King st.....	Eastern ave....	18 "	"	143		
							7,167	
37	Czar st.....	North st.....	Queen's Park...	15 "	"	180		
							180	

*Reconstruction.

SCHEDULE No. 4.—*Continued.*

No.	STREET.	FROM.	TO.	SIZE.	DESCRIPTION.	Length in Yards.	Total length of various kinds.
38	Catherine st....	Peter st	West end.....	12 inches..	Pipe.	94	
39	Sultan st.....	East end.....	St. Thomas st	12 "	"	160	
	St. Thomas st	Sultan st.....	Czar st.....				
40	Surrey Place ...	Breadalbane st.	Grosvenor st...	12 "	"	123	
41	St. David st....	Parliament st...	Easterly	12 "	"	73	
							450

IN PROGRESS.

No.	STREET.	FROM.	TO.	SIZE.	DESCRIPTION.
1	Hope street.....	Buller street	Bloor street.....	3 x 2 feet.	Brick
2	Queen street.....	Sherbourne street	Westerly	3 x 2 "	"
3	Queen street.....	Trefann street....	Sumach	18 inches.	Pipe..

Making a total of 81.22 miles of sewers of all sizes in the City, (the length of reconstructed sewers not included in this total, the length of the old sewers having already been counted.)

Abstract of size, length, and cost of Private Drains constructed in 1882.

7,741 yards of 6 in. tile pipe drains.....	
1,864 yards of 9 in. tile pipe drains.....	$9,596 72
17 yards of 12 in. tile pipe drains.....	
Superintendence on above	1,642 00

This work has been done under 672 separate applications.

SCHEDULE No. 5

No. of Manholes and Flushing Shafts constructed on Old Sewers for 1882, *where none existed previously; also, List of Sewers Cleaned and Flushed.*

Queen Street, Strachan Street to Yonge Street	19
Queen Street, Yonge to Jarvis Street	5
Lombard Street, Victoria Street to Jarvis Street	5
Wellington Street, Bay Street to Yonge Street	3

List of Sewers Flushed.

Queen Street, Yonge westerly.
St. Alban's Street.
Bloor Street, Yonge to Fark Fence.
Wellington Street, Bay to Yonge.
Melinda Street, Bay to Yonge.
Muter Street, Robinson to Arthur.
Foxley Street.
Argyle Street, Dundas to Dovercourt Road.
Dovercourt Road, Dundas to Queen.
Lumley Street, Robinson to Arthur.
Lane between Queen and Richmond, Bathurst to Tecumseth.
Adelaide Street, Bathurst to Portland.
Lombard Street, Victoria to Jarvis.
Carlton Street, Yonge to Church.
Charles Street, Jarvis to Church.
Victoria, Street, Gould to Gerrard.

SCHEDULE No. 6.

Table Shewing the Locality, Length & Width of Paved Roadways constructed, 1882.

No.	Street.	From	To	Length in Feet.	Width of Roadway Paved in Feet.
1	Argyle	Dundas	Gladstone Ave.	2,130	24
2	Arthur	Bathurst	Lumley	950	24
3	Baldwin	Beverley	Huron	570	24
4	Baldwin	Huron	Spadina Avenue	410	24
5	Berkeley,	Gerrard	Carlton	670	24
6	Beaconsfield Ave	Queen	Saurin	1,460	24
7	Brookfield	Queen	Maple	490	24
8	Beverley	Queen	College	3,340	24
9	Bleeker	Carlton	Howard	2,920	21
10	Brunswick Ave	College	Buller	1,190	24
11	Bellevue Ave	College	Bellevue Place	1,450	24
12	Brock	King	Front	1,010	42
13	Cecil	Beverley	Spadina Avenue	1,050	24
14	College	Beverley	Spadina Avenue	1,100	39
15	Dovercourt Road	Dnudas	Argyle	1,160	24
16	Dovercourt Road	Queen	Argyle	960	24
17	D'Arcy	Beverley	Spadina Avenue	1,050	24
18	Earl	Huntley	Sherbourne	600	18
19	Huntley	Bloor	Earl	1,310	21
20	Howard	Bleeker	Sherbourne	210	24
21	Henry	Baldwin	Cecil	450	24
22	Harbord	St. George	Huron	410	24
23	Henry	College	Cecil	610	24
24	King	Strachan	Railway Crossings	1,790	30
25	Linden	Huntley	Sherbourne	590	24
26	Lumley	College	Robinson	2,790	24
27	Lisgar	Queen	Saurin	1,460	24
28*	Lane between Yonge and Jordan	Melinda	Wellington	230	10
29	McCaul	Grange Road	Anderson	660	35
30	Murray	Caer Howell	North End	1,020	21
31	Nassau	Spadina Avenue	Lippincott	1,660	21
32	Oxford	Spadina Avenue	Grosvenor Ave	1,110	24
33	Orde	College Avenue	West End	610	21
34	Parliament	Queen	Gerrard	2,490	33
35	Prospect	Rose Avenue	Parliament	330	21
36	Rose Avenue	Winchester	Wellesley	810	24
37	Rose Avenue	Wellesley	Howard	1,260	24
38	St. James' Avenue	Ontario	Parliament	660	18
39	St. Patrick Street	Huron	Spadina Ave	420	24
40	St. George	College	Bloor	3,240	24
41	Sullivan	Beverley	Spadina Ave	1,050	24
42	Yonge	Gould	Bloor	4,850	42
				52,530	

Total ..... 52,530 lineal feet = 9.94 miles.

* Stone.

SCHEDULE No. 7.

List of Permanent Roadways to be laid next Year, for which By-laws have been prepared.

No.	Street.	From	To	Description of roadway, with length in feet.	
				Cedar.	Stone.
				Feet.	Feet.
1	King	River Don	Strachan Ave	16,000	
2	Queen	River Don	Railway Crossing	18,800	
3	Brock	King	Queen	1,150	
4	Yonge	Melinda	Esplanade		1,100
5	Russell	St. George	Spadina Ave	740	
6	Gladstone Ave	Queen	Dundas	2,550	
7	Foxley	Dundas	Dovercourt Road	950	
8	Buchanan	Yonge	Terauley	700	
9	Cameron	Queen	The "Bend."	800	
10	High	Spadina Ave	Esther	800	
11	Woolsley	Esther	Bathurst	1,150	
12	Carlton Ave	Ontario	Easterly	250	
13	Huron	College	Sussex Ave	2,450	
14	McCaul	Anderson	College	1,850	
15	Howard	Bleeker	Parliament	1,200	
16	Sumach	Gerrard	Carlton	900	
17	Bellwood Ave	Queen	Conway	2,800	
18	Dundas	Queen	The "Bend."	1,850	
19	Lane between Front and Esplanade	Yonge	Scott	300	
20	Charles	Jarvis	Church	650	
21	Berkeley	Wilton Ave	Gerrard	1,050	
22	Lisgar	Saurin	Dundas	850	
				57,790	1,100
			Total miles	11.11	

SCHEDULE No. 8.

SPECIAL APPROPRIATIONS.

Sewer Reconstruction.

Huntley Street, Appropriation	$1,240 00
" Expenditure	1,155 14
Balance	$84 86
Sherbourne Street, Appropriation	$5,100 00
" Expenditure	4,407 00
Balance	693 00

Street Extensions.

Arthur Street, balance from 1880-1	$3,000 00
" Appropriation	2,000 00
	$5,000 00
" Expenditure	3,155 00
Balance	$1,845 00
Eastern Avenue, Balance from 1880-1	$4,700 00
" Appropriation	1,000 00
	$5,700 00
" Expenditure	4,187 72
Balance	$1,512 28
Garrison Creek, Straightening :	
" Balance from 1881	$ 138 64
" Expenditure	00 00
Balance	$ 138 64

Bridges.

Crawford Street, Appropriation	$4,000 00
" Expenditure	3,057 50
Balance	$ 942 50
Eastern Avenue, Balance of Appropriation from 1881	$ 54 55
" Expenditure	00 00
Balance	$54 55
Gerrard Street, Balance of Appropriation from 1881	$225 75
" Expenditure	28 90
Balance	$196 85

SCHEDULE No. 9.

Return of Material on hand, year ending 31st December, 1882.

WESTERN DIVISION.

In Corporation Yard, Spadina Avenue :—5 yds. gravel ; 3 yds. sand ; 40,000 feet b. m. lumber ; 12 culvert grates ; 6 man-hole covers ; 3 culvert traps ; 4,000 bricks ; 100 feet sewer pipe ; 75 toise stone, lying at various points.

EASTERN DIVISION.

In Corporation Yard, Frederick Street :—11 flushing shaft covers ; 10 man-hole covers ; 90 iron steps ; 49,327 feet b. m. lumber ; 2 kegs nails ; 50 toise stone lying at various points.

REPORT TO THE CITY COUNCIL OF DETROIT, MICH., ON THE PAVEMENT QUESTION, BY THE HEALTH OFFICER.

To the Honourable the City Council:

GENTLEMEN: The following resolution of your honourable body was officially communicated to me without delay:

By Councilman Watson:

Resolved, That the Health Officer be requested to give his opinion upon the healthfulness of wood for paving purposes, and to report to this Council."—Adopted.

A heavy pressure of work in the Health Department during the hot season of the year, together with the time taken for a careful investigation of a difficult subject, have caused some delay in the preparation of my report.

Your resolution seems to confine me to the single question of the healthfulness of wood for paving purposes.

Comprehensively viewed, the question involves the method of construction and the kind of wood used.

And it also involves a comparison with other kinds of pavement.

I must therefore beg your indulgence if I consider the whole difficult and complex question of paving the streets of the city, not only from the sanitary point of view, but also from the engineering point of view, inasmuch as the material used and the method of construction, determines, in a great measure, the problem of healthfulness. Noise, and the vibration communicated from pavements to adjacent buildings, as well as decaying organic matter on the streets, become important factors in a thorough sanitary discussion. The question of cost, where the power of taxation is properly and necessarily limited, must be taken into account even in the consideration of healthfulness.

FOUNDATIONS FOR PAVEMENTS.

A proper foundation is an essential part of any pavement. A poor pavement on a good foundation may be better than a good pavement on a poor foundation. "A firm and unyielding foundation," says Gen. Q. A. Gilmore, the highest authority on the subject, "is quite as necessary for the stability and endurance of a pavement, as for any other structure. The best wearing surface ever devised, combining excellence of material and workmanship in the highest degree, would soon give way and become worthless under the wear and tear of a very moderate traffic if placed upon a weak and insufficient foundation."

"The following are suitable foundations for street pavements, provided their thickness is judiciously adapted to the character of the subsoil and the nature of the traffic, viz.: (1) hydraulic cement five to eight inches in thickness; (2) rubble-stone set on edge, side by side, but not in close contact, with the interstices filled with hydraulic concrete; (3) an old coal-tar pavement, properly brought to slope; (4) rubble-stone set on edge and wedged

closely in contact, like the sub-pavement of a Telford road; (5) an old pavement of stone blocks, cobble-stone or rubble-stone; and (6) an old macadamized or gravel road, or a compact layer of broken stone or gravel eight to ten inches thick. These foundations are named in the order of their value."

The story of short-lived pavements in many a city is already told in these few sentences from an eminent engineer who has made pavements a special study. The moral might be pointed and the tale adorned by quoting the parable of the wise man who built his house upon a rock and the foolish man who built his house upon the sand. The sanitary quality of a pavement is improved equally with its stability by a good foundation. The most unsanitary material, well laid on a proper foundation, is more wholesome than the most sanitary material broken up and more or less mingled with underlaying mud and stagnant, polluted water.

Coal tar pavements, wooden block pavements, stone block pavements, and asphalt pavements are alone used at the present time on the streets of cities.

As coal tar pavements are worthless in our variable and rigorous northwestern climates, they may be dismissed from further consideration.

WOODEN BLOCK PAVEMENTS.

In American cities a very large amount of rectangular pine blocks set on the end, have been used for pavement. Of late this kind of material has given way to circular cedar blocks. In the older cities the use of wood has been discontinued in a great measure. It is likely to disappear entirely after a few more years of unfavourable experience.

The first cost of wooden-block pavement, as it is usually laid, is not so great as that of stone or asphalt. If cedar blocks were properly treated to prevent decay; if only sound blocks were used; if all joints between the blocks when laid were filled with bituminous cement; if a suitable foundation were well and carefully prepared, this kind of pavement would be much more durable than it now is; but in that case it would be nearly if not quite as expensive as stone pavement. As Gen. Gilmore says, "Blocks of wood would soon be crushed if set upon a rigid inelastic foundation." Hence it is necessary to set them on a board or plank foundation, or on a foundation of earth very carefully prepared and packed to an even firmness with a heavy roller.

As usually laid, wooden block pavement is short-lived. When new, it is smooth, noiseless, agreeable to drive on, and affords excellent footing for horses. For these reasons it has commended itself greatly to public favour. But it wears uneven and soon begins to decay. The average life of wooden block pavement is about five years. Granite block pavement lasts six times longer. Allowing, then, the first cost of wood pavement to be $1.30 per square yard, paving once with granite at $2.60 per yard would be equal to paving six times with wood, at an aggregate cost of $7.80 per yard. There would be some saving in interest, which would be more than offset by the greater cost of keeping wood pavement in repair.

The expense of keeping wooden block pavement in the city of Detroit in a

condition to be used will appear from the following very important communication from the Controller:

CONTROLLER'S OFFICE, August 2, 1882.

DEAR SIR,—In reply to your request for information, the following is taken from the books of this office:

Cost of Repairing Wood Pavement.

Labor and Materials.	Fiscal Year.		
	1879.	1880.	1881.
Pay-roll, laborers, repairing	$6,313 71	$7,017 36	$8,323 36
Pay-roll, labourers, hauling and piling blocks	25 00	111 26	.....
Pay-roll, inspectors, cutting blocks	135 75	196 13	340 00
Cedar blocks	7,256 60	3,329 71	9,874 30
Sand and gravel	3,047 55	3,367 48	4,293 98
Total	$16,778 61	$14,021 91	$22,831 64

The "sand and gravel" covers also the repairing of stone pavements; but as there are few of such streets, it is fair to estimate that at least three-quarters of this material was used on the wooden pavements. The limit for forced pavement is now $75,000 per annum.

Yours truly,

H. P. BRIDGE,
Controller.

DR. O. W. WIGHT,
Health Officer.

There can be no doubt that wooden block pavements are by far the costliest in the long run, of any pavements now in use. No city can afford them.

The hygienic objections to wooden block pavements are very grave.

M. Toussagrives, professor of hygiene at Montpelier, France, truly says: "The hygienist cannot look favorably upon a street covering consisting of a porous substance capable of absorbing organic matter, and by its own decomposition giving rise to noxious miasma, which, proceeding from so large a surface, cannot be regarded as insignificant. I am convinced that a city with a damp climate, paved entirely with wood, would become a city of marsh fevers."

Mr. P. Le Neve Foster, secretary of the Society for the Encouragement of Arts, Manufactures and Commerce, reports (London, 1873): "Impregnation of the wood with mineral matters, to preserve it from decay, may diminish these evils; but nothing as yet tried prevents the fibres being separated, and the absorption of dung and putrescent matter by the wood being continued. The condition of absorbing mere moisture is of itself bad; but when the sur-

face absorbs and retains putrescent matter, such as horse dung and urine, it is highly noxious. The blocks of pavement with this material are separated by concussion and are thus rendered permeable to the surface moisture."

Another member of the same Society, who had had large experience as a member of the Common Council of the City of London, said: "Wood is porous; it is composed of bundles of fibres; it absorbs and retains wet, foul wet especially. The fibres of the wood are placed vertically, the upper ends whereof fray out, are abraded, and become like painters' brush stumps, and are almost permanently dirty, or they break like the handle of a chisel which has been struck with an iron hammer or wooden mallet."

"The joints of a block pavement," says Gen. Gilmore, "constitute fully one-third of its entire area; and under the average care the surface of filth exposed to evaporation covers three-fourths of the entire street. The foul organic matter, composed largely of the urine and excrement of different animals, is held in the joints, ruts and gutters, where it undergoes putrefactive fermentation in warm, damp weather, and becomes the fruitful source of noxious effluvium, or it floats in the atmosphere and penetrates the dwelling in the form of unwholesome dust, irritating to the eyes and poisonous to the organs of respiration."

Dr. Fordyce Barker, in a letter to the New York *Times* concerning the pavement, says: "The imperfect drainage and the want of cleanliness * * * are shortening the lives of our citizens, and are not only maintaining, if not increasing the death rate, but surely inviting pestilence to the city. * * * Crevices will always afford lodgments for comminuted decaying organic matter, furnishing a fertile soil for fungoid development. Especially is this the case where the pavements have become broken or sunken, forming receptacles which collect and conserve those rejected elements of life which at the same express time invoke death. * * * It is unnecessary to say of the wooden pavements that they are open to all these objections, * * * and they must be given up, as any one may see who will take the trouble to drive the streets in which they have been laid."

Prof. Wm. H. Brewer, of Yale College, an eminent chemist, says: "It is well known that all woods contain certain nitrogenous organic compounds, known chemically under the general name of albuminoids, and that these substances are active in inducing and favoring rot. All chemical methods for the preservation of timber from decay look towards getting this nitrogenous portion into some less soluble condition, or into some combination less liable to chemical change. When green wood is well soaked in cold water, a considerable quantity of such albuminoid matter is dissolved out, remaining in the water. This solution, even when very dilute, is extremely putrescible—more so, indeed, than any person would deem possible until he had tried the experiment. The fact is as true of the hardest woods, as maple and locust, as it is of soft wood." To what Prof. Brewer says may be added the chemical fact that this "extremely putrescible solution, acts as a leaven in setting

up putrefactive fermentation in organic matters constantly deposited upon street pavements." Even "in the free air and full sunlight," adds Prof. Brewer, "along with the putrescence a white fungus growth begins on the surface of the wood, which rapidly becomes slimy. This forms much more rapidly on the ends of the grain of the wood than on the radial or tangential sides. The fungus growth goes on, modified, of course, by the temperature and the degree of concentration, and it continues offensive for an unknown period, or until the decay has become complete. Heart-wood and sap-wood act essentially alike in this matter; the difference is one of degree rather than character."

On sanitary grounds, therefore, I must earnestly protest against the use of wooden block pavements. Such blocks, laid endwise, not only absorb water which dissolves out the albuminoid matter that acts as a putrefactive leaven, but also absorb an infusion of horse manure and a great quantity of urine dropped in the street. The lower ends of the blocks resting on boards, clay or sand, soon become covered with an abundant fungoid growth. Thoroughly saturated with albuminous extract and the excreta of animals in a liquid, putrescible form, these wooden block pavements undergo a decomposition in the warm season and add to the unwholesomeness of the city. The streets, in fact, might as well be covered a foot deep with rotting barnyard manure, so far as wholesomeness is concerned. Moreover, the interstices between the blocks, and the perforations of decay, allow the foul liquids of the surface to flow through, supersaturating the earth beneath, and constantly adding to the putrifying mass.

STONE BLOCK PAVEMENTS.

Of course stones will not decay and will not yield albuminoid substance to act as a leaven of putrefaction. Otherwise stone pavement, as usually laid, will be just as objectionable as wooden block pavement, with the addition of intolerable noise. "In fact," says Dr. Barker, "it is next to impossible to thoroughly cleanse stone pavement." "Very few appreciate," he adds, "the effect of persistent noise on the nervous system. When our business men die, they fall with little or no premonition, like soldiers in the crash of battle. The toughest railway iron is shattered by a sufficient number of comparatively slight blows. It exists without external change, but interiorly its filiform structure gradually becomes granular, and the end of the transition is marked by the blow which fractures the rail. So the strong business man, accustomed to the din of travel and traffic, endures it for a period without evidence of injury, until one day comes when the nervous system, suddenly shattered, announces the close of the business career and the imminence of dissolution."

"A quiet and noiseless street pavement," says Dr. A. McLane Hamilton, "would enhance the health of the population to a great extent. The sufferer from nervous diseases would find relief from the noise of empty omnibuses and waggons rumbling or rattling on the rough stones, in the event of the removal of this nuisance. In fact there would be many more benefits resulting from a change than I can here detail."

"As for invalids," again says M. Toussagrives, "quiet is of the first importance, and the noise of the streets is the cruelest stumbling-block in the way of recovery."

"The noxious exhalations," says Gen. Gilmore, "emanating from the fœcal and other putrescent matter collected and held in the joints of stone pavements constitute another sanitary objection to their use in populous towns. Objections to wood may be taken upon the same and even upon stronger grounds."

Stone pavement may be laid in such a manner as to obviate filth, but not in such a manner as to obviate noise. "The granite block pavement," says Lieut. Green, a very eminent authority on the subject, "laid on a foundation of gravel and sand, and filled in the joints with a cement of coal tar, gives great satisfaction in business streets where the travel is heavy. The experience in Paris and London puts the life of this character of pavement (when laid without cement in the joints) at about thirty years, with an annual expense of about ten cents a yard for maintenance and repairs. There is every reason to believe that the stone pavement laid in this city (Washington) will prove equally durable, and that the cement in the joints, by making the pavement water tight, and giving the blocks mutual support, will reduce the annual cost of maintenance to two or three cents a square yard.

It is exactly the "cement in the joints" that will obviate all the sanitary objections to stone pavement but the din and roar of travel and traffic, which no device can overcome. Since Lieut. Greene wrote the report from which I make the above quotation, in 1880, further experience proves the correctness of his views. In his report of 1881 he reiterates his commendation of "a pavement of granite blocks laid on a foundation of well-rolled gravel and sand, and cemented with tar and gravel in the joints for streets of confined travel or steep grades." The cost of it in Washington is $2.28 per yard. The cost here would be about $2.60 per yard. The ultimate cost of wooden block pavement is three times greater. The granite block has the advantage in everything but noise.

ASPHALT PAVEMENT.

"The best asphalt pavement," says Gen. Gilmore, "is one having a foundation bed of hydraulic cement, or something equivalent thereto in firmness and durability; and for its wearing surface either the natural bituminous limestone, known as asphalt rock, derived from the Jurassic region on the confines of Switzerland, or, preferably thereto, an artificially compounded mixture of refined asphaltum and silico-calcareous sand, in which the calcareous ingredient is finely pulverized limestone. As the material for the first-named pavement comes principally from the vicinity of Neufchatel, the pavement is known as the Neufchatel pavement. The asphaltum for the other pavement referred to comes from the Island of Trinidad, and the pavement is sometimes called the Trinidad asphalt pavement, although more generally known as the Grahamite pavement, from the corporate name of the company with which it originated."

The Neufchatel pavement has been extensively used in Paris, London and other European cities. It is laid on Pennsylvania Avenue in Washington, between the Capitol and Sixth Street. As the Neufchatel pavement is very expensive and becomes very slippery when worn, it is not likely to be used much in the United States. It costs $20 a ton to import the material of which it is made. The chief engineer of the streets of Paris reported to the American Minister a few years ago that this pavement "becomes excessively slippery in times of damp fogs and fine rains," and that "it is very difficult to make the necessary repairs to it during the winter in case of frosts or continuous rains." It may therefore be dismissed from further consideration here.

The asphalt pavements of this country are thus described by Lieut. Greene: "A foundation of six inches of hydraulic cement concrete, and a wearing surface of bituminous mastic laid in two coats, respectively a half inch and two inches thick when compressed. The mastic is composed of the following parts by weight:

Asphalt cement (refined Trinidad asphalt, 100 parts; petroleum oil, 20 parts)	15	to	18
Limestone powder	15	to	17
Sand	70	to	65
Totals	100		100

"The theory of this pavement is a solid base of concrete masonry, practically imperishable, and a comparatively thin and smooth wearing surface which can be replaced when it is worn out—say, every fifteen or twenty years. The concrete base is easily made, and satisfies all the conditions; in making the wearing surface there are many practical difficulties which require constant attention and skilled, experienced labor. The pavement is subjected to a temperature of 150 degrees above zero in summer and 10 degrees below zero in winter—a range of 160 degrees Fahrenheit—at all of which temperatures it is required to represent a uniform surface."

About half a million yards of this pavement has been laid in Washington. In New York, Boston, Philadelphia and Baltimore successful experiments have been made with it. It is being laid on Linwood Avenue in Buffalo this year. It has never been tried in this city or the cities further west. The so-called asphalt pavements, with which we have had some unfavorable experience, are patented combinations of coal tar, resin, pitch, lime, gravel, sulphur, etc.

"The many advantages," says Gen. Gilmore, "of a good asphalt pavement, like the Trinidad, may be briefly summarized as follows: (1) It produces no dust, and therefore no mud; (2) It is comparatively noiseless; (3) It does not absorb and retain noxious liquids, but facilitates their prompt discharge into the side gutter and catch basins; (4) It is impermeable to moisture, and never emits nor allows the emission from the subsoil of unwholesome and poisonous vapors. It reduces the force of traction, and consequently the

wear and tear upon animals and veichles to the minimum; and (5), although it does not furnish as secure a foothold for animals as rough blocks of stone, wood or asphalt concrete, it does not become polished and slippery from continual wear."

This pavement has received the highest indorsement of the most competent judges in this country. Prof. C. H. Chandler expresses his "belief that the pavement will be found to answer all the requirements of hardness, toughness and uniformity under the extreme heat and cold to which it will be exposed in our climate." Gen. H. G. Wright, chief of the engineer corps of the United States army, regards it as "far better than the French, which is so largely used in the pavement of Paris, and which has been hitherto regarded as the best known." The late Major Wm. J. Twining, United States engineer corps, second to no man in ability to judge of this matter, said three years ago: "For all streets which are not exclusively used for heavy trucking or like business purposes, which have a reasonable width for the diffusion of traffic and upon which the grades are easy, I regard the asphalt pavement as the cheapest and best, taking into consideration ease and comfort in driving, freedom from the annoyance of noise, and consideration of public health, which depend upon the general cleanliness of the streets."

This pavement answers to all sanitary requirements. It contains no material that is acted on by the acid or alkaline solvents of liquid filth. It is tenacious, firm, durable, yet elastic and smooth. It is less noisy than even wooden block pavement. It costs less than stone for repairs, and next to stone lasts longest. It is comparatively impervious to liquids of any kind. It is free from dust, and can be be cleaned by water as easily as a china plate. The sheet asphalt can be adapted to an old pavement of stone or a macadam road bed, as well as to a special layer of hydraulic concrete. No pavement can be so perfectly mended when cut into by plumbers. As sixty five to seventy per cent. of sand enters into its composition, it affords good footing for horses. It communicates no vibrations to adjoining buildings, thus slowly weakening and disintegrating their structure. It saves great cost of wear and tear to animals and vehicles. It makes so smooth a surface that street railway companies could substitute on it Herdic coaches, in great measure, for clumsy cars, to the great relief of the people.

Two questions naturally present themselves: 1 Whether this pavement could be made to stand the severe cold of our climate. 2 Whether we could and would procure the skilled and experienced labor to lay it.

As to the first question, Gen. Gilmore writes me, under date July 31, 1882, in answer to a special inquiry whether this pavement could be made to stand twenty-five degrees below zero and 160 degrees above zero: "A variation of 185 degrees (160+25) would certainly be a severe test on asphaltum, but I would not hesitate to put down the pavement under suitable guarantees from the company." Dr. J. S. Billings, U. S. A., of Washington, who has been an enlightened and scientific observer of the Trinidad asphalt pavement, writes me that the "proportion of oil should be a little higher to stand twenty-five

degrees below zero." It has stood the cold of Boston well, where the winters are quite as severe as in Detroit. It stands the heat of Philadelphia and Washington, which is more intense than that of our city.

As to the second question, the skilled and experienced labor can be had by paying for it. Since Boss Shepherd and his wooden blocks were cast out of the national capital like spirits of evil, and charge of the streets has been given to army engineers, who are free from all ring and political influences, Washington has become the best paved city in the world. In putting down asphalt pavement such care is exercised that an expert chemist is employed to test the material as fast as the work progresses.

The cost of this pavement in Washington is $2.07 a yard. It would cost more here, especially at the outset. The Washington contractor writes me that he is now paving Linwood avenue in Buffalo at $2.70 per yard. Even at that price the expense of it would be considerably less than one-half of the ultimate cost of wooden block pavement.

Asphalt block pavement is more expensive, far inferior in quality, and open to most of the sanitary objections already enumerated against wood and stone.

In conclusion, I would respectfully recommend, especially from the sanitary point of view, as well as from this economic point of view, that wooden block pavement may be abandoned altogether; that stone block pavement be used on streets of heaviest traffic, as the lower end of Woodward avenue, Gratiot avenue, the western end of Jefferson avenue and portions of Atwater and Woodbridge streets, the blocks to be of granite rather than Medina sandstone, 12 inches long by 4 inches wide, laid transverse to the roadway on a well-rolled foundation of gravel and sand, the joints to be filled water-tight with coal tar and gravel cement; and that all other streets be paved with Trinidad asphalt on a monolithic bed of hydraulic cement concrete six inches thick. In my judgment it would be better to pave all gutters and spaces between street railway tracks with stone as above described.

It has been suggested that hard burned bricks, boiled in coal tar, might be successfully substituted for stone in the construction of pavements. Bricks thus treated are very tough, durable and easily handled. I have been shown a specimen which has been in use nine years with very little wear. The treatment makes the brick impervious to water, and it is said that the adhering tar will completely cement the brick together when laid. It is claimed that such a pavement is noiseless, easily cleaned, and protects the underlying earth from pollution by foul surface liquids. Mr. Lloyd, the architect, can give you more information on this subject than I can. It looks to me hopeful that brick thus treated may be successfully used for gutters and paving between street railway tracks, in preference to stone.

As during the next few years several millions must be spent in Detroit for pavement, I would earnestly suggest the wisdom of selecting a commission of five, one from each Council, two from other departments of the municipal

government, and one as a special representative of the heavy taxpayers of the city, with instructions to visit Washington, Philadelphia, New York, Boston and Buffalo, for the purpose of carefully studying the whole subject of street pavements and ascertaining the best results of the experience of other cities. The cost of thorough investigation will be but a few hundred dollars. The cost of blindly following defective methods may be millions.

Respectfully submitted.

O. W. WIGHT,
Health Officer.

Accepted, placed on file and ordered printed.

Extract from an Article on Resistance to Traction on Roads, by Rudolph Hering, President of the Engineers' Club of Philadelphia; read March 18, 1882.

The following table presents the results of experiments on the resistance of vehicles to traction on different classes of roads. The fractions which are generally rounded off, indicate the part of the whole weight, which is equivalent to the resistance of drawing it on a level road. An examination of this table will clearly show the great economy in horse-power, by using the hardest and smoothest roads. For instance, if one horse can just draw a load on a level road on iron rails, it will take $1\frac{2}{3}$ horses to draw it on asphalt $3\frac{1}{3}$ on the best Belgian block pavement, 5 on the ordinary Belgian pavement, 7 on good cobble stones, 13 on bad cobble stones, 20 on an ordinary earth road, and 40 on a sandy road:

Character of Road.	Resistance in terms of load.	Velocity.	Authority.
Sand	1-5	pace.	Bevan.
Sandy road	1-12	3′ and 12′ per sec.	Morin.
Loose gravel	1-7	pace.	Bevan.
Gravel 4″ thick	1-10	pace.	Morin.
Common Gravel road	1-16	pace.	Macneil.
Gravel road	1-26	3′ per sec.	Rumford.
Gravel road	1-25	12′ per sec.	Rumford.
Hard rolled gravel	1-30	pace.	Bevan. Minard.
Wet turf	1-8	pace.	Morin.
Hard and dry turf	1-18	pace.	Morin.
Hard and dry turf	1-25	.....	Bevan.
Ordinary earth road	1-10	pace.	Bevan.
Hard clay	1-20	.....	Bevan.
Hard and dry earth road	1-22—1-30	pace.	Morin.
Ordinary cobblestone	1-8	trot.	
Ordinary cobblestone	1-16	pace.	
Good cobblestone ($3\frac{1}{2}$″)	1-15	trot.	Kossack.
Good cobblestone ($3\frac{1}{2}$″)	1-30	pace.	Kossack.
Good carriage with springs	1-25	pace.	Kossack.
Macadam little used	1-16—1-23	.....	Morin.
Bad macadam	1-14	pace.	Gordon.
Old macadam	1-20	.....	Navier.
Ordinary macadam	1-25	trot.	Macneil.
Ordinary macadam	1-35	pace.	Perdonnet. Kossack.
Good macadam (wet & slightly muddy)	1-30—1-54	.....	Morin.
Best French macadam	1-50	.....	Navier.
Very hard and smooth macadam	1-50	.....	Macneil.
Best macadam	1-35	trot.	Rumford.
Best macadam	1-45	pace.	Rumford.
Best macadam	1-46—1-60	.....	Gordon.
Best macadam	1-43—1-70	.....	Morin.
Ordinary stone block	1-25	.....	Perdonnet. Poncelet. Minard.
Ordinary Belgian block	1-40	pace.	Macneil.
Good stone block	1-17	trot.	Rumford.
Good stone block	1-50	pace.	Rumford.
Belgian Block, Boulevard, Paris	1-42—1-66	.....	Navier.
Good Belgian block	1-30	trot.	Rumford.
Good Belgian block	1-60	pace.	Rumford.
Good London block	1-62	.....	Gordon.
Well laid Belgian block	1-65	.....	Macneil.
Good Belgian block	1-45—1-87	.....	Morin.
Plank roadway (bridge)	1-40—1-57	.....	Morin.
Asphalt	1-133	.....	Gordon.
Granite tramway	1-166	.....	Gordon.
Iron tramway	1-200	.....	Gordon.
Sleighs on snow, 3″ thick, $\frac{3}{4}$″ runners, temperature 26°	1-80	.....	